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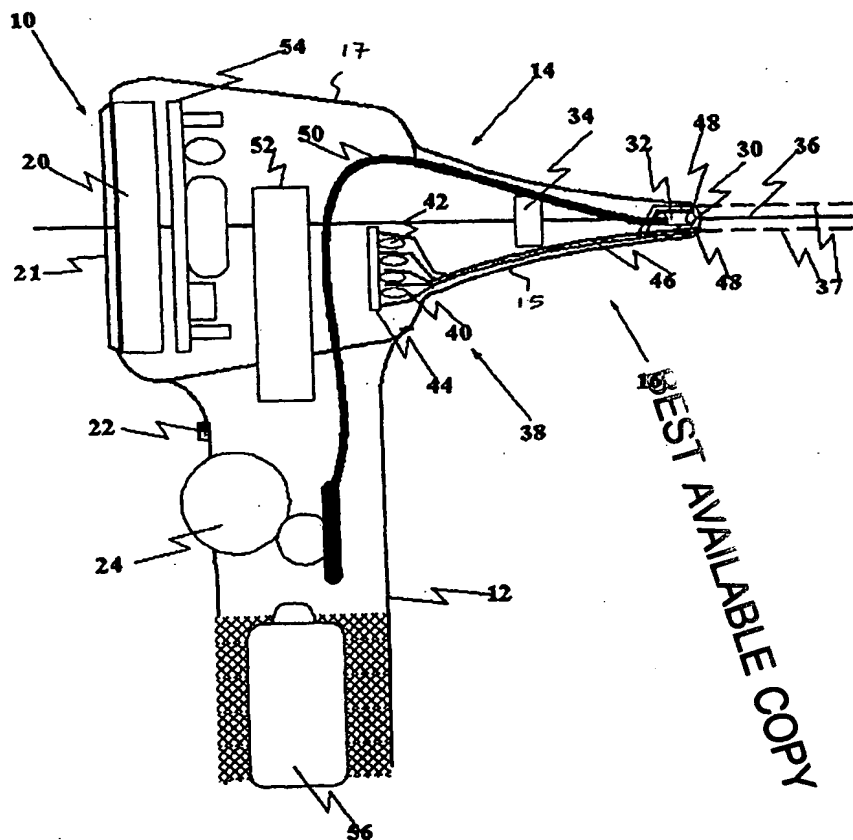
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(54) Title: HAND HELD INSPECTION DEVICE

## (57) Abstract

The present invention includes an inspection instrument (10) for use in medical, dental, law enforcement, other inspection, examination and surveillance procedures. The device includes a body (12) having an integral speculum (14) with a video image capturing device or camera (16), a power supply and a video display (20). These components, in addition to user actuated controls, are disposed integrally with the body (12). The body is adapted for convenient engagement and manipulation by a user's hand to provide a unitary, hand held device capable of illuminating, capturing an image of a subject, and displaying the image. The video display (20) is disposed on a display portion of the speculum, while components of the image capture device, such as a lens (30), and light emitter are disposed on a nose portion (15) of the speculum. The nose portion is modularly replaceable with alternate nose portions sized and shaped to facilitate various discrete inspection procedures.



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HAND HELD INSPECTION DEVICE

5

## BACKGROUND OF THE INVENTION

## 10 1. Field of the Invention

The present invention relates to hand held inspection instruments, and more particularly to an integrated hand held viewing scope and display for medical, dental, law enforcement, and other related fields.

15

## 2. Background Information

Various hand held instruments for use by a physician or dentist during examination of a patient have been known in the art for many years. Such hand held instruments include  
20 the otoscope for examination of the ear, ophthalmoscope for examination of the eye, larynx illuminator (throat), nasal pharynx illuminator (nasal passages), dermatologic magnifier (skin) and anoscope (lower G.I. tract).

Also, in the prior art, it has been known to employ  
25 miniature or micro-video cameras in connection with various surgical and surveillance procedures. Examples of such video cameras are known as remote head color CCD cameras. These cameras typically employ an array of semiconductive chips using a technology known as charge coupled diode  
30 sensors. Such micro-cameras are capable of yielding more than 500 lines of resolution per axis, resulting from the use of 400,000 or more pixels. Use of such micro-video cameras and related equipment, such as endocouplers, have been known for some time in connection with certain types of

surgery and, particularly, surgery conducted through the use of small incisions in the body wall in videoendoscopy procedures. Such procedures have become increasingly commonplace in connection with procedures upon the gall  
5 bladder, appendix, intestine, etc., where the problem is of an internal nature.

In addition to relatively widespread use of such micro-video technology in the operating room, which includes the display of a procedure upon separate monitors, this  
10 technology has also been utilized in the dentist's or physician's office in the context of otherwise routine examination and diagnosis. An example of an instrument incorporating this technology is shown, for example, in U.S. Patent No. 5,762,605, issued to Cane et al. This device  
15 discloses a hand held optical diagnostic instrument including a CCD sensor and an external light source. The instrument is coupled to a discreet monitor, which may permit both patient and physician to observe an image of the examination. Moreover, devices of this type may be utilized  
20 to produce a video record of such an examination and/or provide either a videotape of the examination or selected print frames thereof.

Such devices may also be used to provide a video link to a satellite or other communications means from a video  
25 interface of the system. This may enable consultants to be utilized either in real time, or in a batch mode, to provide "second opinions" to the examining medical personnel or paramedic who may be located in a geographically remote region and/or may possess limited skills in the specialty to  
30 which the examination relates. Such activity has become known as telemedicine.

A disadvantage of such devices, however, is that they tend to be awkward to use, as such instruments tend to be difficult for the examining physician to hold, to manipulate and to obtain the necessary views for the examination while simultaneously viewing the image on the remote monitor. This is due to the need for the examining care provider to manipulate the instrument relative to the patient, while looking away from the patient to the monitor. Thus, while many prior art instruments may be designed to facilitate manipulation by the user, the ergonomics of such devices tends to divert the user's attention away from the patient during examination, which may result in discomfort to the patient due to errant manipulation of the instrument. This drawback may be particularly problematic with respect to new users, or those with minimal training in the use of such instruments.

Similar disadvantages generally pertain to inspection devices used in the law enforcement field, such as used to surveil the interior of a premises by viewing beneath a closed door, through a keyhole or through a hole drilled into a wall or ceiling, etc.

Thus, a need exists for an ergonomically improved hand-held inspection instrument.

25

#### SUMMARY OF THE INVENTION

According to the present invention, an inspection instrument includes a body adapted for engagement by a user's hand, a speculum integrally disposed within the body, an image capture device, a light source and a video display. The image capture device, light source and video display are disposed integrally within the body.

In another aspect of the present invention, an inspection instrument includes a body adapted for engagement by a user's hand, the body including a speculum disposed integrally therewith, and an image capture device disposed integrally within the body, the image capture device having a central optical axis. A light source is also disposed integrally within the body, the light source being adapted to emit light along at least one light emission axis disposed substantially parallel to the central optical axis. A video display is disposed integrally with the body and is coupled with the video capture device to display an image captured thereby.

A still further aspect of the present invention includes a method of examining a patient, which comprises the steps of:

- (a) utilizing an instrument including:
  - a body adapted for engagement by a user's hand, the body including a speculum disposed integrally therewith;
  - an image capture device;
  - a light emitter;
  - the image capture device and the light emitter being disposed integrally with the body; and
  - a video display disposed integrally with the body; and
- (b) manipulating the instrument relative to a patient while the user simultaneously faces both the patient and the video display.

In another aspect, the present invention includes an instrument having a body adapted for engagement by a user's hand. The body includes an integral speculum, a lens and a light outlet, and an integral video display.

In a variation of these aspects, the lens and light outlet are disposed integrally within a nose portion of the speculum. In a further variation, the nose portion comprises a modular unit adapted for alternate engagement and disengagement with said body. Further still, a plurality of modular nose portions may be provided with various sizes and shapes to facilitate discrete examining procedure

#### 10 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a partially perspective elevational view of an inspection instrument of the present invention in use relative to a patient;

15 Fig. 2 is an enlarged, broken-away elevational view of a portion of the instrument of Fig. 1;

Fig. 3 is a block diagram of the componentry of the present invention;

Fig. 4 is a perspective view of the instrument of Fig. 1 including an additional component of the present invention;

Fig. 5 is a perspective view of a plurality of instruments of Fig. 1 disposed in an optional charging device; and

25 Figs. 6a-6e are elevational views of alternate embodiments of the inspection instrument of the present invention.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

30

As shown in Figs. 1-3, the present invention includes an inspection instrument 10 for use in medical, dental, law

enforcement and other inspection, examination and surveillance procedures. The device includes a body 12 including an integral speculum 14 with a video image capture device or camera 16, a power supply and a video display 20. These components, in addition to user actuatable controls including a power switch 22 and image focus control 24, are preferably disposed integrally with the body 12. (Portions of the image capture device, such as image sensor 34, as will be discussed hereinbelow, may be disposed remotely from the body 12, and coupled thereto through a port 28.) The body 12 is adapted for convenient engagement and manipulation by a user's hand. The video display is disposed on a display portion of the speculum, while components of the image capture device, such as a lens and light emitter, are disposed on a nose portion of the speculum. As shown in Figs. 6a-6e, the nose portion is modularly replaceable with alternate nose portions sized and shaped to facilitate various discrete medical/dental and other inspection or examination procedures. The present invention thus provides a unitary, hand-held device capable of illuminating and capturing an image of a subject such as patient, and displaying the image.

As used herein, the term "light" is defined as electromagnetic energy within the range of frequencies or wavelengths extending from infrared to ultraviolet radiation and including visible light. The term "speculum" as used herein, shall refer to a portion of an instrument adapted for being inserted into a cavity and/or placed externally in image capturing proximity of a patient or other subject, for inspection thereof.

Turning now to the Figures in greater detail, as shown in Fig. 1, inspection instrument 10 comprises a unitary body



12 including a manually engagable grip portion 13 and a speculum portion 14. As also shown, body 12 includes an integral video display 20 as well as user actuatable controls including a power or on/off switch 22 and a focus control 24. The instrument 10 also includes integral battery recharging contacts 26 and one or more external ports 28, which will be discussed hereinbelow.

Turning now to Fig. 2, lens 30 of the image capture device 16 is disposed within the speculum 14 of the instrument 10. Moreover, in the embodiment shown, various components of the image capture device 16, including lens 30 disposed within a lens housing 32, and an image sensor 34, are preferably disposed within the speculum 14. As also shown, lens 30, housing 32 and sensor 34 are all disposed in image capturing alignment with one another to capture images disposed generally along an axis of examination 36. Such image capturing alignment may be provided by disposing both the lens 30 and sensor 34 along a common axis (i.e., axis 36) as shown. Alternatively, this image capturing alignment may be provided by utilizing an optic coupling such as a light pipe, fiber optic coupling or other wave guide (similar to fiber-optic coupling 46 discussed hereinbelow) to couple the lens 30 with the sensor 34. One skilled in the art will recognize that use of such an optic coupling advantageously permits the sensor 34 to be disposed at various locations within the instrument 10, either on or off the axis of examination 36. Moreover, as mentioned hereinabove, such an arrangement may also facilitate use of a remote sensor 34, such as a remote digital camera, coupled optically and/or electronically to lens 30 through a port 28. Instrument 10 also includes an internal light source 38 which includes a light generator 40 such as an array of

light emitting diodes (LEDs) 42 disposed on a printed circuit board 44. Light source 38 further includes an optical coupling such as a light pipe or fiber-optic coupling 46 optically coupled to a light outlet 48. As shown, light outlet 48 preferably includes distal or terminal portions of the light pipe 46 which are splayed for disposition about the periphery of lens housing 32. As shown, each of these terminal portions extends substantially parallel to axis of examination 36 to emit light along light emission axes 37 which are substantially parallel to the examination axis 36. Depending on the application (as discussed hereinbelow with respect to Figs. 6a-6e), such substantially parallel light emission may include light emitted along one or more light emission axes 37 oriented to extend either slightly convergently towards axis 36, or slightly divergently away from axis 36. In this regard, the instrument 310 of Fig. 6d may utilize one or more slightly convergently disposed light emission axes to illuminate a relatively small area of a patient. Conversely, instrument 210 of Fig. 6c may utilize slightly divergent light emission axes, or a combination of convergent and divergent light emission axes, to illuminate a relatively larger area of the patient (i.e., to inspect a region of a patient's skin). In this manner outlet 48 emits light nominally coaxial with axis of examination 36.

Although light generator 40 preferably includes LEDs 42 as shown, any suitable light generation means, such as miniature incandescent bulbs, compact florescent lighting, or one or more lasers may be utilized. Image sensor 34 may be any suitable miniature video image capture device known to those skilled in the art, such as, for example form factor video cameras, semiconductor chip mounted CCD

devices, or other devices commonly utilized in the field of electronic or digital photography. In this regard, the image capture device 16 of the present invention provides nominally the same capabilities commonly associated with conventional digital cameras and the like, namely, the ability to digitally capture, store and retrieve images for display and/or transmission. Such image transmission may be accomplished in a known manner, such as by use of port 28.

As also shown, a focus control switch 24, such as a user actuatable thumb wheel as shown, is operatively coupled by cable 50 to the lens housing 32 to focus the image captured by image sensor 34. In one embodiment, focus control 24 may include a mechanical gear-type control which actuates a cable 50 to effect focusing movement of the lens 30 relative to sensor 34 in a known manner. In such an embodiment, cable 50 may be a conventional mechanical cable. In an alternate embodiment, cable 50 may include an electric wire which serves to couple electrical signals from focus control 24 to an electrical actuator (not shown) coupled to the lens 30 to effect the focusing movement.

Moreover, all or a portion of speculum 14 is advantageously coupled modularly, i.e., in a snap-fit type arrangement, to the body 12 to permit convenient replacement and/or substitution thereof to facilitate various discrete uses. For example, a nose portion 15 (also referred to as "lens sub-system") of the speculum 14 may be modularly engagable with the display portion 17 thereof, as will be discussed in greater detail hereinbelow with respect to Figs. 6a-6e.

The instrument power supply includes a DC-DC converter 52 electrically coupled to a DC-AC power inverter 54. Power inverter 54 is, in turn, electrically coupled to video

display 20. In a preferred embodiment, as shown, instrument 10 includes an internal power source such as a rechargeable or non-rechargeable battery 56 electrically coupled to DC-DC converter 52. Video display 20 is preferably a color liquid crystal display (LCD) monitor disposed integrally within body 12 in spaced relation to lens housing 32 along axis of examination 36 at a proximal end of speculum 14. An example of a suitable display 20 is known as a 1.8 inch (4.6 cm) high density LCD display available from Prime View International Co., Ltd., Model number is P18BD1. Moreover, in a preferred embodiment, the substantially planar screen portion 21 of display 20 is disposed substantially orthogonally to the axis of examination 36. Such placement of monitor 20 advantageously places a displayed image generally within a natural line of sight of speculum 14 defined by axis of examination 36. This use of the integral video display 20 advantageously provides an integrated one-piece instrument 10 which enables a user to view an image which moves in a natural and intuitive manner in response to movement of the instrument 10 by a user. Advantageously, this action facilitates proper use with little or no training to generally enable a user to operate the instrument with greater tactile sensitivity than prior devices which utilize discreet video displays located remotely from the image sensing device. The use of an integral display 20 disposed within the axis of examination 36 also advantageously tends to improve the efficiency of the examination procedure by enabling the user to look in a single direction for viewing the image captured on the monitor 20, the instrument 10 and the subject (i.e., patient) while manipulating the instrument 10. This aspect thus provides improved ergonomics to enable manipulation of

the instrument 10 with greater accuracy than prior art devices which generally require the user to manipulate the device while looking away from the patient to view a remote monitor.

5           Turning now to Fig. 3, a rechargeable power source 56 is electrically coupled to contacts 26 which, in turn, are adapted for connection to an AC power source 58. Internal power source 56 is coupled to DC-DC converter 52 which, as shown, is coupled to a light generator 40 which is coupled  
10 to light pipe 46. DC-DC converter 52 is also coupled to the DC-AC inverter 54 to supply power to a backlight 60 of video display 20. As further shown, DC-DC converter 52 provides power to a video converter 62 which provides an electronic image signal to the display 20 as well as to external video  
15 port 28. Port 28 may be coupled a remote video display 64, either directly, or via a computer network (i.e., an intranet or the Internet. As also shown, lens 30 is optically coupled to sensor 34 which is, in turn, electronically coupled to the video converter 62. Focus  
20 control 24 is electrically and/or mechanically coupled to the lens 30.

Turning now to Fig. 4, in a preferred embodiment inspection device 10 is adapted for being coupled by its external video port 28 to a remote monitor 64. The remote  
25 monitor 64 may comprise a LCD display, television monitor, and the like, and is preferably wall mounted or movably mounted to enable a patient to view captured images in real time as the dentist or physician views the captured images on the integral display 20. This aspect of the present  
30 invention thus provides the user with a useful tool for explaining and or describing the examination process to the patient. Moreover, the image may be recorded by connecting

the video output to a suitable image recorder such as a computer or VCR or other recording device.

As shown in Fig. 5, an AC powered recharging base 66 may be utilized to receive one or more instruments 10 for recharging power source 56 by coupling external charger contacts 26 (Fig. 1) to AC power supply 58 (Fig. 3).

Turning now to Figs. 6a-6e, in addition to the instrument 10 discussed hereinabove, various alternate embodiments of the present invention are shown as instruments 110, 210, 310 and 410. These embodiments are substantially similar to instrument 10, while utilizing various modular nose portions to facilitate discrete medical/dental examination procedures, as mentioned hereinabove. Nose portion 15 (Fig. 6a) of the speculum 14 is thus modularly engagable with the display portion 17 thereof for convenient replacement with various alternate nose portions 115, 215, 315 and 415 (Figs. 6b-6e, respectively). In this regard, an electric focus control arrangement utilizing an electric cable 50, as discussed hereinabove with respect to Fig. 2, is preferably provided.

Moreover, a light source 38 and image capture device 16 (Fig. 2) are preferably disposed entirely within each modular (removable) nose portion. These arrangements advantageously simplify modular connection between the nose portions and the display portion 17, by permitting use of conventional modular electrical connectors. Alternatively, the light source 38 may be disposed within the display portion 17, with the light pipe 46 (Fig. 2) fabricated as two discrete portions that are axially aligned with one another when a particular modular nose portion is engaged with the display portion 17.

As shown, instrument 10 may be conveniently utilized to enable a physician to examine a patient's ear, nose, and throat. As shown in Fig. 6b, an extended and slightly angled nose portion 115 may be utilized to examine a patient's middle meatus, inferior meatus, superior meatus, and oropharynx. A reversed cone nose portion or lens subsystem 215 as shown in Fig. 6c, may be utilized to examine a patient's skin. An extended nose portion 315, as shown in Fig. 6d, may be utilized to examine animals such as horses, cows, and the like. As shown in Fig. 6e, an offset lens subsystem 415 may be utilized to facilitate rectal examinations and the like.

In addition, nose portion 115 or 415 as shown in Figs. 6b and 6e, or variations thereof may be used in law enforcement applications, such as to view an interior of a premises by inserting the nose portion into an opening such as beneath a closed door, into a keyhole or into a hole drilled into a wall or through a ceiling into the premises.

One skilled in the art will recognize that the size and/or shape of the nose cones shown and described with respect to Figs. 6a-6e may be further varied, such as by further lengthening noses in a direction of axes 36, 136, 236, 336 and 436 as required to extend through walls or ceilings and the like. In addition, the nose portions may be manufactured from flexible materials, such as by use of flexible light pipes or fiber optic cables, to permit the nose portion to be "snaked" through crevices in walls or ceilings, etc.

In these alternate embodiments of Figs. 6b-6e, the substantially planar screen portion 21 of display 20 is disposed substantially orthogonally to either the respective axis of examination 136, 236, 336 or 436, or to a plane

which includes the axis of examination. As discussed above with respect to instrument 10, such placement of monitor 20 advantageously places a displayed image generally within a natural line of sight of speculum 14 defined by the axis of examination. This use of the integral video display 20  
5 advantageously provides an integrated one-piece instrument 10 which enables a user to view an image which moves in a natural and intuitive manner in response to movement of the instrument 10 by a user.

10 Although various components of the present invention have been shown and described as being disposed within various nose portions 15, 115, 215, 315 and 415, it should be recognized by those skilled in the art that any arrangement of components may be included or removed from  
15 the nose portions without departing from the spirit and scope of the present invention.

Moreover, although several alternate configurations of nose portions or lens subsystems have been provided, those skilled in the art should recognize that nose portions or  
20 lens subsystems of substantially any geometry or construction may be utilized without departing from the spirit and scope of the present invention.

The foregoing description is intended primarily for purposes of illustration. Although the invention has been  
25 shown and described with respect to an exemplary embodiment thereof, it should be understood by those skilled in the art that the foregoing and various other changes, omissions, and additions in the form and detail thereof may be made therein without departing from the spirit and scope of the  
30 invention.

Having thus described the invention, what is claimed is:



CLAIMS

1. An inspection instrument comprising:  
a body adapted for engagement by a user's  
hand;  
a speculum integrally disposed within said  
body;  
an image capture device and a light source, said image  
capture device and said light source being  
disposed integrally within said body; and  
a video display disposed integrally with said body.
2. The inspection instrument of claim 1, further  
comprising a power supply disposed integrally with said  
body.
3. The inspection instrument of claim 2, further  
comprising a power source disposed integrally with said  
body.
4. The inspection instrument of claim 1, wherein said  
image capture device and said light source are disposed  
integrally within said speculum.
5. The inspection instrument of claim 1, wherein said  
image capture device further comprises a lens disposed  
in optical communication with an image sensor.
6. The inspection instrument of claim 5, wherein said  
light source emits light substantially coaxially with a  
central optical axis of said image capture device.

7. The inspection instrument of claim 6, wherein said light source further comprises a light emitting diode.
8. The inspection instrument of claim 1, further comprising a user actuatable power switch disposed integrally on said body.
9. The inspection instrument of claim 8, wherein said power switch is operable by a user's thumb.
10. The inspection instrument of claim 1, further comprising a power supply disposed integrally within said body.
11. The inspection instrument of claim 10, wherein said power supply is adapted for being coupled with an external power source.
12. The inspection instrument of claim 11, wherein said power supply further comprises charging circuitry adapted to recharge rechargeable batteries disposed integrally with said body.
13. The inspection instrument of claim 12, wherein said charging circuitry further comprises contacts disposed externally on said body, said contacts adapted for power coupling contact with an external power source when said body is received within a charger.
14. The inspection instrument of claim 1, further comprising video circuitry adapted to couple said video imaging device with said video display.

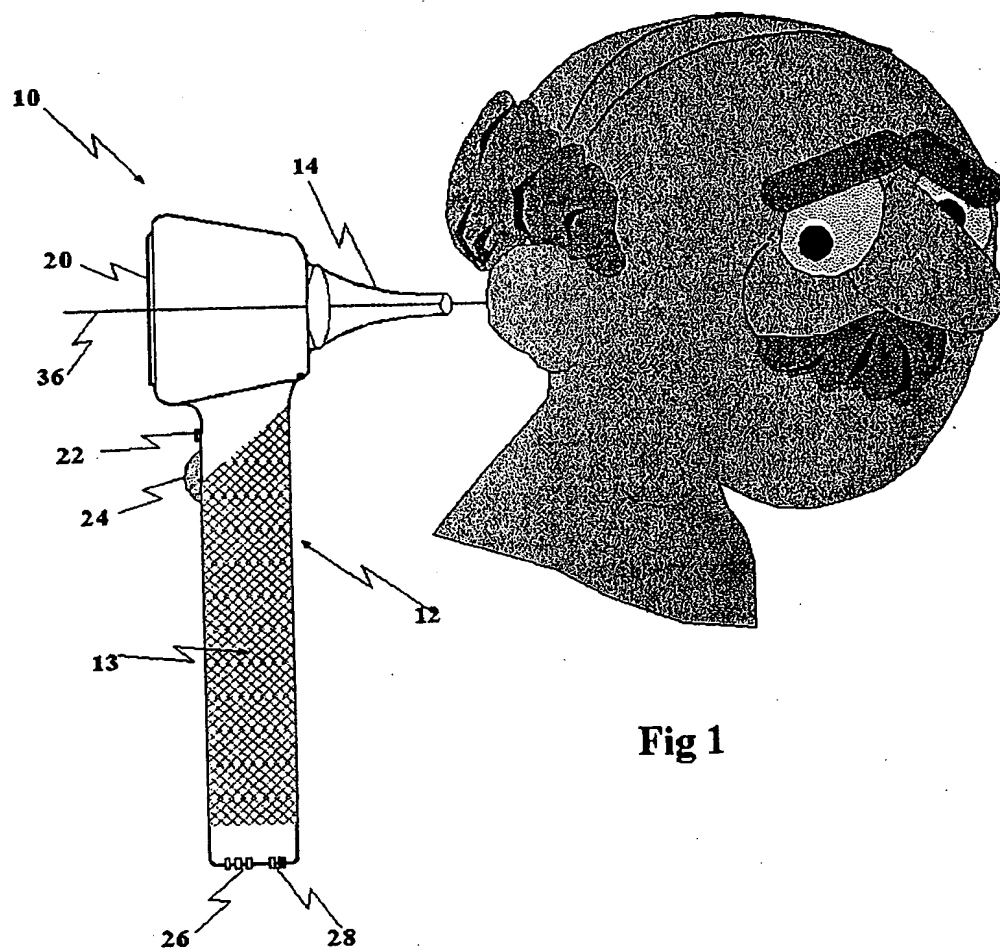
15. The inspection instrument of claim 14, wherein said video circuitry further comprises an external port disposed on said body, said external port adapted to couple with an external video display.
16. The inspection instrument of claim 15, further comprising an external video display.
17. The inspection instrument of claim 1, wherein said image capture device is adapted to capture an image of an object disposed within an axis of examination of said instrument and said video display is disposed within said axis of examination.
18. The inspection instrument of claim 17, wherein said video display further comprises a substantially planar screen portion, said screen portion being disposed substantially orthogonally to said axis of examination.
19. The inspection instrument of claim 17, wherein said video display further comprises a substantially planar screen portion, said screen portion being disposed substantially orthogonally to a plane which includes said axis of examination.
20. An inspection instrument comprising:  
a body adapted for engagement by a user's  
hand;  
said body including a speculum disposed integrally  
therewith;  
an image capture device disposed integrally within

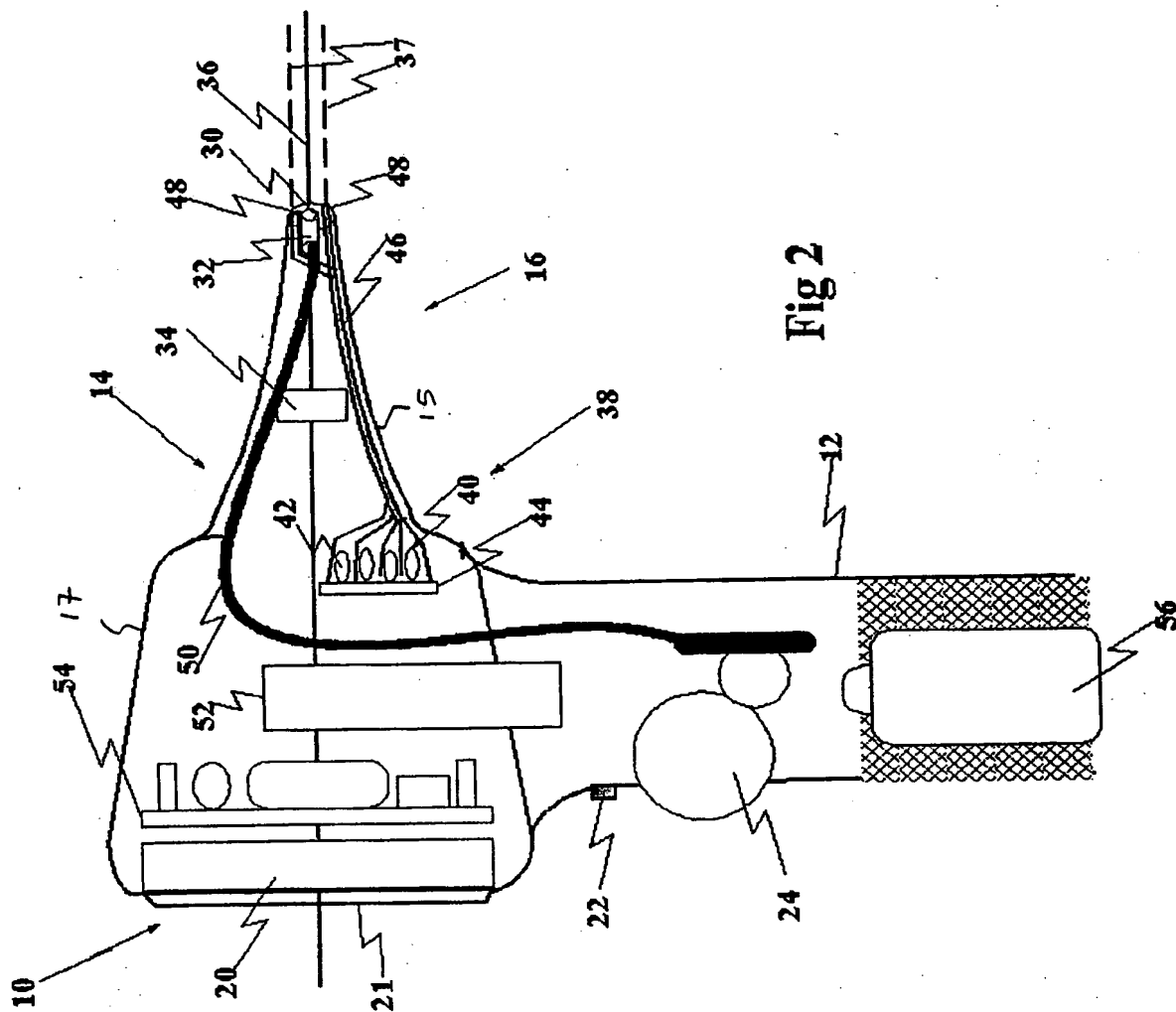
said body, said image capture device having a  
a light source disposed integrally within said body,  
said light source being adapted to emit light  
along at least one light emission axis disposed  
substantially parallel to said central optical  
axis; and  
a video display disposed integrally with said body,  
said video display being coupled with said video  
capture device to display an image captured  
thereby.

21. A method of examining a patient comprising the steps  
of:
  - (a) utilizing an instrument including:
    - a body adapted for engagement by a user's  
hand, said body including a speculum disposed  
integrally therewith;
    - an image capture device;
    - a light emitter;
    - said image capture device and said light emitter  
being disposed integrally with said body; and
    - a video display disposed integrally with said  
body; and
  - (b) manipulating the instrument relative to a patient  
while the user simultaneously faces both the  
patient and the video display.
22. The method of claim 21, further comprising the step of:
  - (c) transmitting the image to a remote display.
23. The method of claim 22, further comprising the step of:
  - (d) recording the image on an image recorder.

24. The inspection instrument of claim 1, wherein said image capture device further comprises an image recorder.
25. The inspection instrument of claim 1, further comprising an image recorder.
26. An instrument comprising:
  - a body adapted for engagement by a user's hand;
  - a speculum integrally disposed within said body;
  - a lens and a light outlet, said lens and said light outlet being disposed integrally within said body;
  - and
  - a video display disposed integrally with said body.
27. The instrument of claim 26, wherein said lens and light outlet are disposed integrally within a nose portion of said speculum.
28. The instrument of claim 27, wherein said nose portion further comprises a modular unit adapted for alternate engagement and disengagement with said body.
29. The instrument of claim 28, further comprising a plurality of said nose portions being interchangeably engagable with said body.

30. The instrument of claim 29, wherein each of said plurality of nose portions are sized and shaped to facilitate discrete examining procedures.







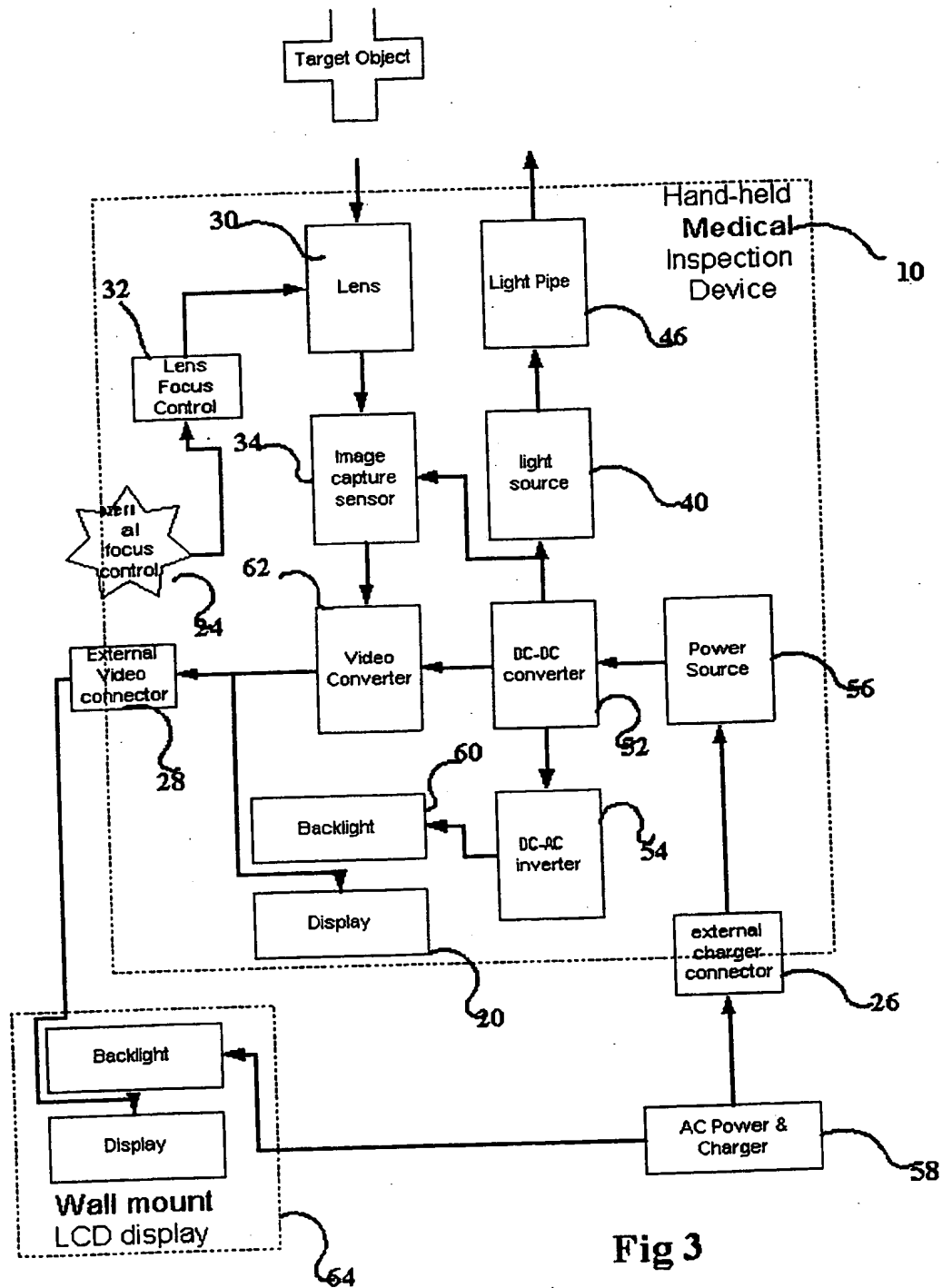


Fig 3

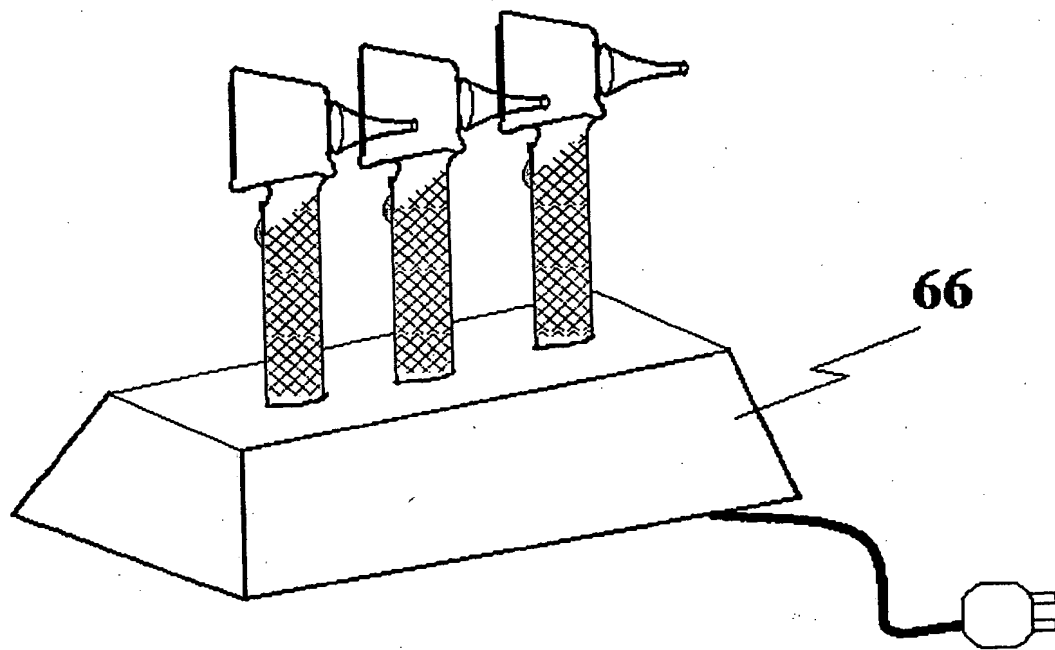
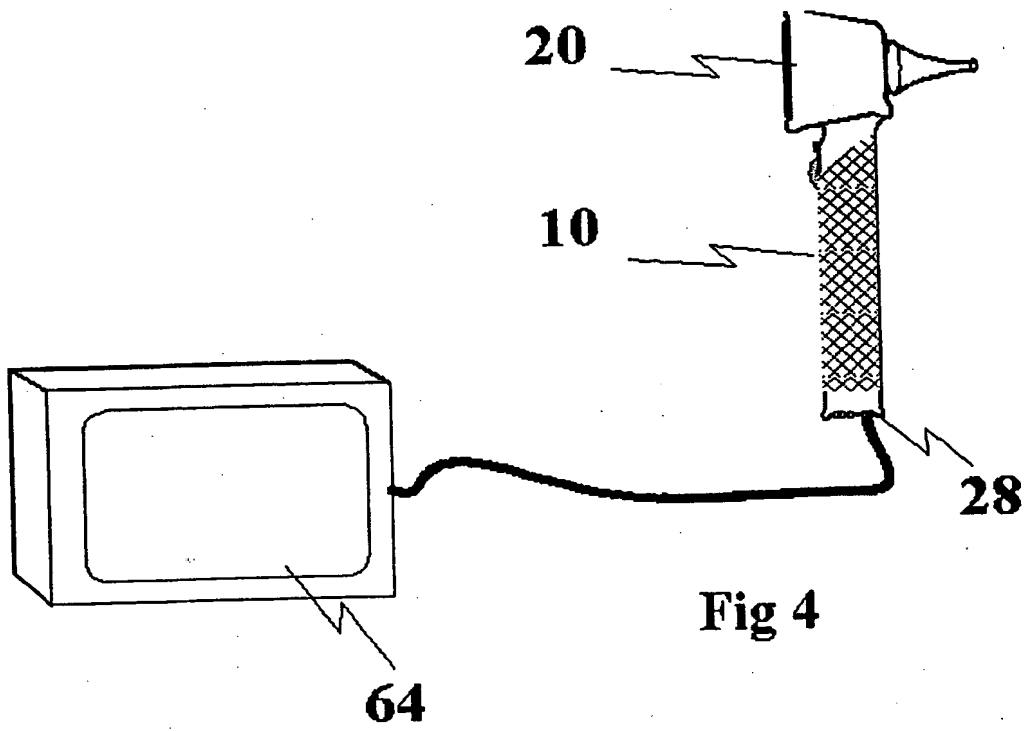


Fig 5

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Fig. 6a

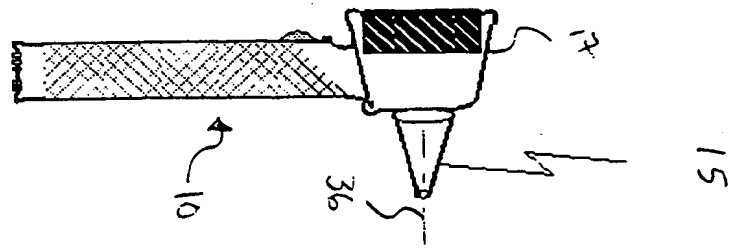


Fig. 6b

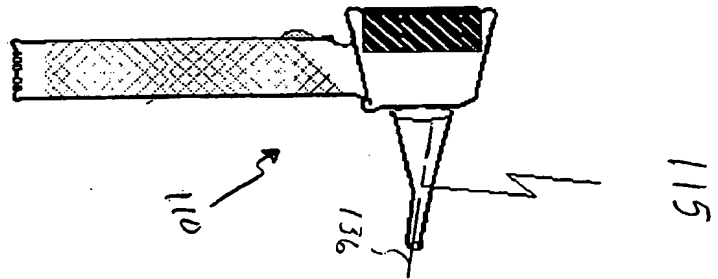


Fig. 6c

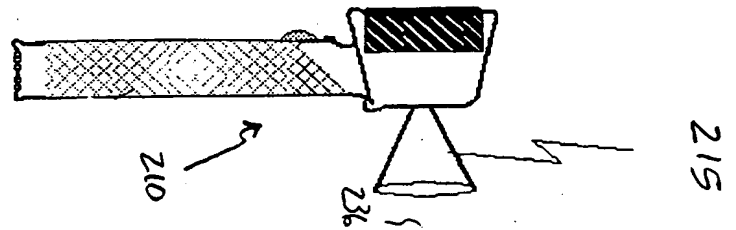


Fig. 6d

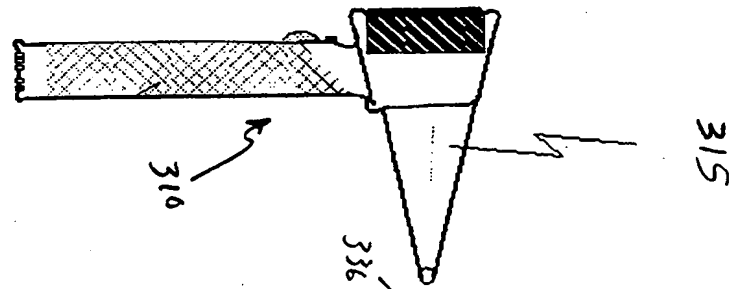
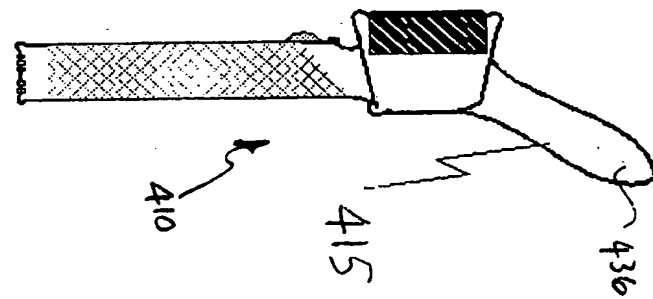


Fig. 6e



# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US99/27884

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : A61B 1/267

US CL : 348/65, 66; 433/29; 600/109, 129-131, 167, 179, 199, 200

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 348/65,66; 433/29; 600/109, 129-131, 167, 179, 199, 200

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X, P	US 5,873,814 A (ADAIR) 23 February 1999, entire document	1, 4-6, 14, 17-21, 24-27
X, P	US 5,879,289 A (YARUSH et al.) 09 March 1999, entire document,	1-3, 8-11, 14-16, 21-23, 26, 28-30
Y	US 4,884,133 A (KANNO et al.) 28 November 1989, col. 1, lines 22-30.	7
Y, P	US 5,885,214 A (MONROE et al.) 23 March 1999, Abstract	12, 13



Further documents are listed in the continuation of Box C.



See patent family annex.

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*P* document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

07 FEBRUARY 2000

Date of mailing of the international search report

07 MAR 2000

Name and mailing address of the ISA/US  
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